CHAPTER 620
RIGID PAVEMENT

Topic 621 - Types of Rigid Pavements

Index 621.1 Jointed Plain Concrete Pavement (JPCP)

JPCP is the most common type of rigid pavement used by the Department. JPCP is engineered with longitudinal and transverse joints to control where cracking occurs in the slabs (see Figure 621.1). JPCPs do not contain steel reinforcement, other than tie bars and dowel bars (see Index 622.4 for tie bars and dowel bars). Additional guidance for JPCP can be found in the "Jointed Plain Concrete Pavement Design Guide" on the Department Pavement website.

621.2 Continuously Reinforced Concrete Pavement (CRCP)

CRCP has been used by the Department on a limited basis in the past. Because CRCP is still a relatively new concept to California, the Department has decided not to use CRCP for TIs less than 11.5 or in High Mountain and High Desert climate regions. Since CRCP uses reinforcing steel rather than weakened plane joints for crack control, saw cutting of transverse joints is not required for CRCP. Longitudinal joints are still used. Transverse random cracks are expected in the slab, usually at 1.0 m to 1.5 m intervals (see Figure 621.1). The continuous reinforcement in the pavement holds the cracks tightly together. CRCP typically costs more initially than JPCP due to the added cost of the reinforcement. However, CRCP is typically more cost-effective over the life of the pavement on high volume routes due to improved long-term performance and reduced maintenance. Because there are no sawn transverse joints, properly built CRCP should have improved ride quality and less maintenance than JPCP. Additional CRCP guidance can be found in the "Continually Reinforced Concrete Pavement Design Guide" on the Department Pavement website.

621.3 Precast Panel Concrete Pavement (PPCP)

PPCPs use panels that are precast off-site instead of cast-in-place. The precast panels can be linked together with dowel bars and tie bars or can be post-tensioned after placement. PPCP offers the advantages of:

- Improved concrete mixing and curing in a precast yard
- Reduced pavement thicknesses, which is beneficial when there are profile grade restrictions such as vertical clearances
- Shorter lane closure times, which is beneficial when there are short construction windows

The primary disadvantage of PPCP is the high cost of precasting. PPCP also needs a smooth base underneath the precast panels during construction to even out the loads on the slab and avoid uneven deflection that could lead to faulting at the joints, slab settlement, and pre-mature cracking. PPCP is currently used on an experimental basis in California, and must follow the procedures for experimental projects and special designs in Topic 606.

Topic 622 - Engineering Requirements

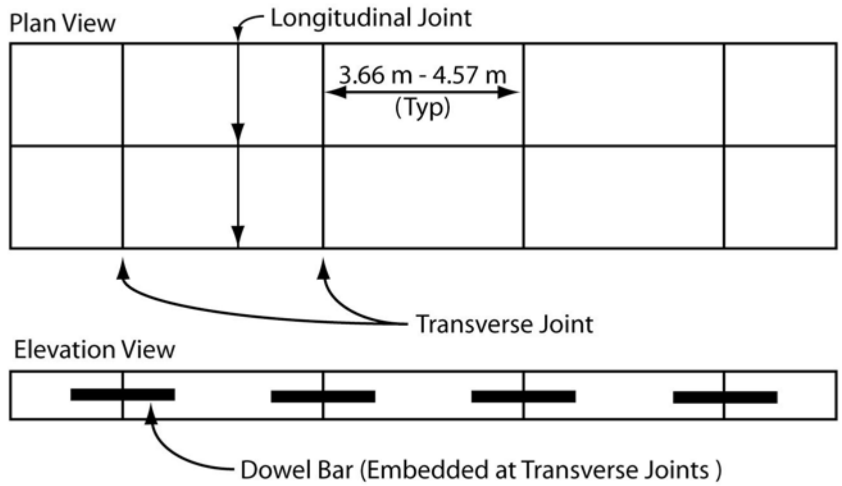
622.1 Engineering Properties

Table 622.1 shows the rigid pavement engineering properties that were used to develop the rigid pavement catalog in Index 623.1. The values are based on Department specifications and experience with materials used in California. The predominant type of cement used in California for rigid pavement is Portland cement concrete. Other types of hydraulic cements are sometimes used for special conditions such as rapid strength concrete.

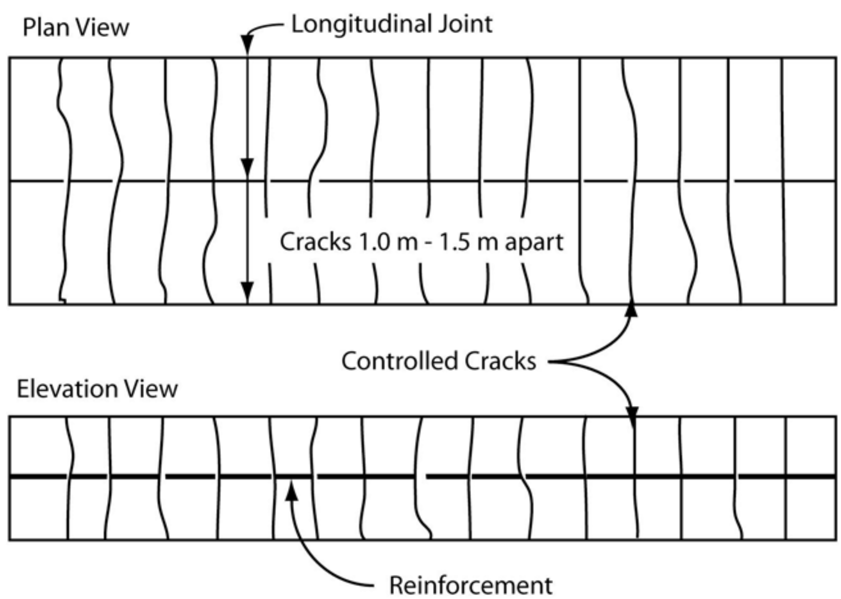
(1) *Smoothness.* The smoothness of a pavement impacts its ride quality, overall durability, and performance. Ride quality (which is measured by the smoothness of ride) is also

Figure 621.1

Types of Rigid Pavement



Jointed Plain Concrete Pavement (JPCP)



Continuous Reinforced Concrete Pavement (CRCP) the highest concern listed in public surveys on pavement condition. Smoothness specifications have been improved and pilot specifications are being evaluated to assure designed smoothness values are achieved in construction. Smoothness specifications should be used where the project meets the warrants for the smoothness specification. For up to date, additional information on smoothness and application of specifications see the smoothness page on the Department Pavement website.

622.2 Performance Factors

The performance factors used to engineer rigid pavements are shown in Table 622.2. The pavement structure in Index 623.1 is expected to meet or exceed all of the performance factors in Table 622.2. The performance factors in the table are end-of-design life criteria.

622.3 Pavement Joints

(1) *Contact.* Contact joints (sometimes called a construction or cold joint) are joints between slabs that result when concrete is placed at different times. Contact joints can be transverse or longitudinal and are constructed in all types of rigid pavements. Tie bars are typically used at contact joints to connect the adjoining slabs together so that the contact joint will be tightly closed.

(2) *Weakened Plane.* Longitudinal and transverse weakened plane joints (also known as contraction joints) are sawed into new pavement to control the location and geometry of shrinkage, curling, and temperature cracking.

(3) *Isolation.* Isolation joints are used to separate dissimilar pavements/structures in order to lessen compressive stresses that could cause uncontrolled cracking. Examples of dissimilar pavements/structures include different joint patterns, different types of rigid pavement (e.g. CRCP/JPCP), structure approach slabs, building foundations, drainage inlets, and manholes. Isolation joints are filled with a joint filler material to keep cracks from propagating through the joint and to prevent water/dirt infiltration.

(4) *Expansion.* Expansion joints (know previously as pressure relief joints) are similar in purpose to isolation joints except they are used where there is a need to allow for a large expansion, greater than 12 mm, between slabs or pavements. Expansion joints are typically used where CRCP abuts up to bridges, structure approach slabs or other types of rigid pavements. Expansion joints are also used with PPCP. Expansion joints are typically not used with JPCP.

Additional information on rigid pavement joints and when, where, and how to place them can be found in the Standard Plans, Standard Specifications/Special Provisions, Pavement Interactive Guide, and the Department Pavement website.

622.4 Dowel Bars and Tie Bars

Dowel bars are smooth round bars that act as load transfer devices across pavement joints. Dowel bars are typically placed across transverse joints. In limited situations, dowel bars are placed across longitudinal joints. See Standard Plans for further details. Tie bars are deformed bars (i.e., rebar) or connectors that are used to hold the faces of abutting rigid slabs in contact. Tie bars are typically placed across longitudinal joints. Further details regarding dowel bars and tie bars can be found in the Standard Plans and Pavement Technical Guidance on the Department Pavement website.

New or reconstructed rigid pavements and lane replacements shall be doweled except as noted below:

- Rigid shoulders placed or reconstructed next to a nondoweled rigid lane may be nondoweled.
- Rigid shoulders placed or reconstructed next to a widened slab may be nondoweled and untied (see Standard Plan P-2).

Table 622.1

Rigid Pavement Engineering Properties

Properties	Values
Transverse joint spacing	4.1 m average
Initial IRI immediately after construction	1.0 m/km (63 in/mile)
Reliability	90%
Unit weight	2400 kg/m^3
Poisson's ratio	0.20
Coefficient of thermal expansion	6.0 x 10^{-6}/ °F
Thermal conductivity	2.16 W/m-K
Heat capacity	1.17 J/g-K
Permanent curl/warp effective temperature difference	top of slab is 5.5 °C cooler than bottom of slab
Surface layer/base interface	Unbonded
Surface shortwave absorptivity	0.85
Cement type	Type II Portland Cement
Cement material content (cement + flyash)	390 kg/m^3
Water: cementitious material ratio	0.42
PCC zero-stress temperature	38.3 °C
Ultimate shrinkage at 40% relative humidity	537 microstrain
Reversible shrinkage (% of ultimate shrinkage)	50%
Time to develop ultimate shrinkage	35 days
Modulus of rupture (28 days)	4.3 MPa
Dowel bar diameter	38 mm (32 mm for rigid pavement thickness < 215 mm)

Table 622.2

Rigid Pavement Performance Factors

Factors	Values
General	
Design Life	Determined per Topic 612
Terminal IRI [1] at end of design life	2.52 m/km max. (160 in/mile)
JPCP only	
Transverse cracking at end of design life	10% of slabs max.
Longitudinal cracking at end of design life	10% of slabs max.
Corner cracking at end of design life	10% of slabs max.
Average joint faulting at end of design life	2.54 mm/km max.
CRCP only	
Punchouts at end of design life	6 per kilometer max.

Note:

(1) The International Roughness Index (IRI) is a nationally recognized method for measuring the smoothness of pavements.

New or reconstructed rigid pavements and lane replacements shall be tied except as noted below:

- Rigid pavement should not be tied to adjacent rigid pavement when the spacing of transverse joints of adjacent slabs is not the same.
- No more than 15 m width of rigid pavement should be tied together to preclude random longitudinal cracks from occurring due to the pavement acting as one large rigid slab. In order to maintain some load transfer across this joint, Standard Plan P-18 includes details for placing dowel bars in the longitudinal joint for this situation.

For individual slab replacements, the placement of dowel bars is determined on a project-by-project basis based on proposed design life, construction work windows, existence of dowel bars in adjacent slabs, condition of adjacent slabs, and other pertinent factors. For further information on slab replacements, see Standard Plan P-8, the "Slab Replacement Guides" and supplementary "Design Tools for Slab and Lane Replacements" on the Department Pavement website.

622.5 Joint Seals

Weakened plane joints should be sealed to prevent incompressible materials from filling the joints and causing the concrete to spall. Seals also limit the entry of water that could otherwise degrade the underlying pavement layers. Various products or systems for sealing joints are available or are being developed. Each one differs in cost and service life. Recommendations on which joint seal to use should be included in the Materials Report. Typically, compression seals are preferred for new construction because of their longer performance life. Liquid sealants should be used for rehabilitation or retrofitting existing joints because they are more adaptable to surface abnormalities. For additional information on various joint seal products, consult the Pavement Technical Guidance on the Department pavement website, Standard Specifications, Standard Special Provisions, Standard Plans, or contact your District Materials Engineer.

622.6 Bond Breaker

When placing rigid pavement over a lean concrete base, it is important to avoid bonding between the two layers. Bonding can cause cracks and joints in the lean concrete base to reflect through the rigid pavement, which will lead to premature cracking. Several methods are available for preventing bonding including a liberal application of wax curing compound, or slurry seals. Application rates may be found in the Standard Specifications. For specific recommendations on how to prevent bonding between rigid pavement and lean concrete base, consult the District Materials Engineer.

622.7 Texturing

Longitudinal tining is the typical texturing for new pavements. Grooving is typically done to rehabilitate existing pavement texture or to improve surface friction. Grinding is typically done to restore a smooth riding surface on existing pavements or for individual slab replacements. Grooving or grinding are options on new pavement in lieu of longitudinal tining where there is a desire to minimize noise levels on rigid pavement.

622.8 Transitions and End Anchors

Transitions and end anchors are used at transverse joints where rigid pavement abuts to flexible pavement, a different rigid pavement type, or in some cases, a bridge to minimize deterioration or faulting of the joint. For JPCP, a pavement end anchor or transition should be used at transitions to flexible pavement. **For CRCP, a terminal anchor or terminal joint shall be used at all transitions to or from structure approach slabs, JPCP, PPCP, or flexible pavement.** Standard Plans include a variety of details for these transitions.

Topic 623 - Engineering Procedure for New and Reconstruction Projects

623.1 Catalog

Tables 623.1B through M contain the minimum thickness for rigid pavement surface layers, base, and subbase for all types of projects. All JPCP structures shown are doweled. The tables are categorized by subgrade soil type and Climate Regions. Figure 623.1 is used to determine which table to use to select the pavement structure.

The steps for selecting the appropriate rigid pavement structure are as follows:

(1) *Determine the Soil Type for the Existing Subgrade*. Soil types for existing subgrade are categorized into Types I, II, and III as shown in Table 623.1A. Soils are classified by the California R-Value and Uniform Soil Classification System (USCS). If a soil can be classified in more than one row in Table 623.1A, then the engineer should choose the more conservative soil type based on the less stable soil. Subgrade is discussed in Topic 614.

(2) *Determine Climate Region*. Find the location of the project on the Pavement Climate Map. The Pavement Climate Map is discussed in Topic 615.

(3) *Select the Appropriate Table (Tables 623.1B through M).* Select the table that applies to the project based on subgrade, soil type, and Climate Region. Use Figure 623.1 to determine which table applies to the project.

(4) *Determine Whether Pavement Has Lateral Support Along Both Longitudinal Joints*. The pavement is considered laterally supported if it is tied to an adjacent lane, has tied rigid shoulders, or has a widened slab. If lateral support is provided along only one longitudinal joint, then the pavement is considered to have no lateral support. As shown in Tables 623.1B through M, pavement thicknesses are reduced slightly for slabs engineered with lateral support along both longitudinal joints.

(5) *Select Pavement Structure*. Using the Traffic Index provided or calculated from the traffic projections, select the desired pavement structure from the list of alternatives provided.

Note that although the pavement structures listed for each traffic index are considered to be acceptable for the climate, soil conditions, and design life desired, they should not be considered as equal designs. Some designs will perform better than others, have lower maintenance/repair costs, and/or lower constructional life-cycle costs. Good engineering judgment should be used in selecting the option that is most effective for the location. For these reasons, the rigid pavement structures in these tables cannot be used as substitutes for the pavement structures recommended in approved Materials Reports or shown in approved contract plans.

Table 623.1A

Relationship Between Subgrade Type(1)

Subgrade Type(2)	California R-value (R)	Uniform Soil Classifications
I	R > 40	SC, SP, SM, SW, GC, GP, GM, GW
II	$10 \leq R \leq 40$	CH (PI $\leq$ 12), CL, MH, ML
III	R < 10	CH (PI >12)

Notes:

(1) See Topic 614 for further discussion on subgrade.

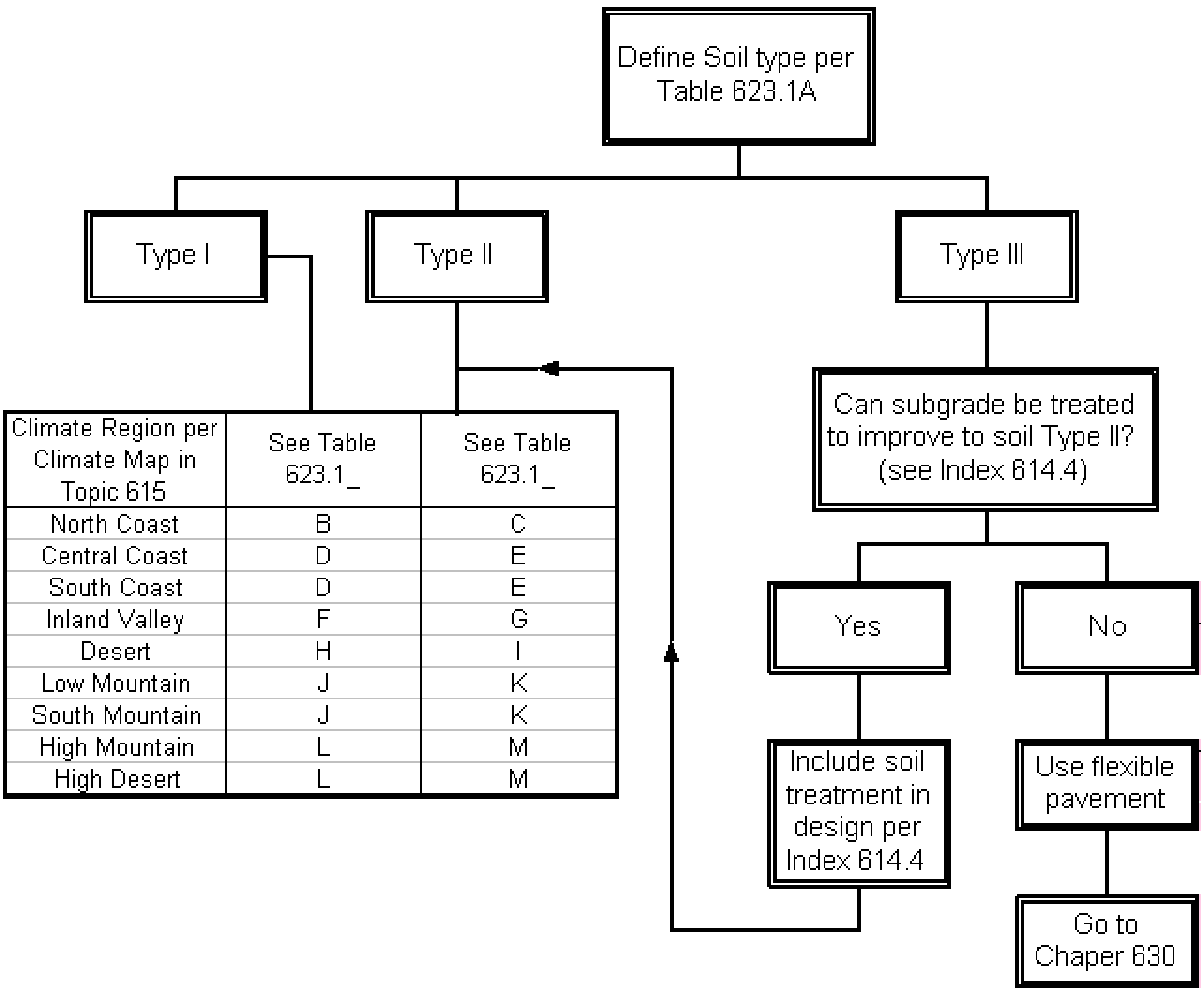
(2) Choose more conservative soil type (i.e., use lower row) if native soil can be classified by more than one row.

Legend

PI = Plasticity Index

Figure 623.1

Rigid Pavement Catalog Decision Tree



Climate Region per Climate Map in Topic 615	See Table 623.1_	See Table 623.1_
North Coast	B	C
Central Coast	D	E
South Coast	D	E
Inland Valley	F	G
Desert	H	I
Low Mountain	J	K
South Mountain	J	K
High Mountain	L	M
High Desert	L	M

Table 623.1B
Rigid Pavement Catalog (North Coast, Type I Subgrade Soil)(1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB	210 JPCP 105 HMA-A	210 JPCP 150 AB	210 JPCP 105 ATPB 105 AS	210 JPCP 105 LCB	210 JPCP 105 HMA-A	210 JPCP 150 AB	210 JPCP 105 ATPB 105 AS
9.5 to 10	210 JPCP 120 LCB	210 JPCP 120 HMA-A	225 JPCP 180 AB	225 JPCP 105 ATPB 120 AS	210 JPCP 120 LCB	210 JPCP 120 HMA-A	225 JPCP 180 AB	225 JPCP 105 ATPB 120 AS
10.5 to 11	210 JPCP 120 LCB	210 JPCP 120 HMA-A	210 JPCP 210 AB		225 JPCP 120 LCB	225 JPCP 120 HMA-A	225 JPCP 210 AB	
11.5 to 12	225 JPCP 120 LCB	225 JPCP 120 HMA-A	225 CRCP 120 HMA-A		240 JPCP 120 LCB	240 JPCP 120 HMA-A	240 CRCP 120 HMA-A	
12.5 to 13	240 JPCP 150 LCB	240 JPCP 150 HMA-A	225 CRCP 150 HMA-A		255 JPCP 150 LCB	255 JPCP 150 HMA-A	240 CRCP 150 HMA-A	
13.5 to 14	240 JPCP 150 LCB	240 JPCP 150 HMA-A	225 CRCP 150 HMA-A		270 JPCP 150 LCB	255 JPCP 150 HMA-A	240 CRCP 150 HMA-A	
14.5 to 15	255 JPCP 150 LCB	255 JPCP 150 HMA-A	240 CRCP 150 HMA-A		285 JPCP 150 LCB	285 JPCP 150 HMA-A	255 CRCP 150 HMA-A	
15.5 to 16	270 JPCP 150 LCB	270 JPCP 150 HMA-A	255 CRCP 150 HMA-A		300 JPCP 150 LCB	300 JPCP 150 HMA-A	270 CRCP 150 HMA-A	
16.5 to 17	285 JPCP 150 LCB	285 JPCP 150 HMA-A	255 CRCP 150 HMA-A		315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
> 17	300 JPCP 150 LCB	300 JPCP 150 HMA-A	270 CRCP 150 HMA-A		330 JPCP 150 LCB	330JPCP 150 HMA-A	300 CRCP 150 HMA-A	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1C
Rigid Pavement Catalog (North Coast, Type II Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
≤ 9	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	210 JPCP 300 AB	210 JPCP 105 ATPB 240 AS	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	210 JPCP 300 AB	210 JPCP 105 ATPB 240 AS
9.5 to 10	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS
10.5 to 11	210 JPCP 120 LCB 180 AS	210 JPCP 120 HMA-A 180 AS	210 JPCP 390 AB		225 JPCP 120 LCB 180 AS	225 JPCP 120 HMA-A 180 AS	225 JPCP 390 AB	
11.5 to 12	225 JPCP 120 LCB 180 AS	225 JPCP 120 HMA-A 180 AS	225 CRCP 120 HMA-A 180 AS		240 JPCP 120 LCB 180 AS	240 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS	
12.5 to 13	240 JPCP 150 LCB 210 AS	240 JPCP 150 HMA-A 210 AS	225 CRCP 150 HMA-A 210 AS		255 JPCP 150 LCB 210 AS	255 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS	
13.5 to 14	240 JPCP 150 LCB 210 AS	240 JPCP 150 HMA-A 210 AS	225 CRCP 150 HMA-A 210 AS		270 JPCP 150 LCB 210 AS	255 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS	
14.5 to 15	255 JPCP 150 LCB 210 AS	255 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS		285 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS	
15.5 to 16	270 JPCP 150 LCB 210 AS	270 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS	
16.5 to 17	285 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
> 17	300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS		330 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1D
Rigid Pavement Catalog
(South Coast/Central Coast, Type I Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB	210 JPCP 105 HMA-A	210 JPCP 150 AB	210 JPCP 105 ATPB 105 AS	210 JPCP 105 LCB	210 JPCP 105 HMA-A	225 JPCP 150 AB	225 JPCP 105 ATPB 105 AS
9.5 to 10	210 JPCP 120 LCB	210 JPCP 120 HMA-A	225 JPCP 180 AB	225 JPCP 105 ATPB 120 AS	225 JPCP 120 LCB	225 JPCP 120 HMA-A	240 JPCP 180 AB	240 JPCP 105 ATPB 120 AS
10.5 to 11	225 JPCP 120 LCB	225 JPCP 120 HMA-A	240 JPCP 210 AB		240 JPCP 120 LCB	240 JPCP 120 HMA-A	255 JPCP 210 AB	
11.5 to 12	240 JPCP 120 LCB	240 JPCP 120 HMA-A	240 CRCP 120 HMA-A		255 JPCP 120 LCB	255 JPCP 120 HMA-A	240 CRCP 120 HMA-A	
12.5 to 13	255 JPCP 150 LCB	255 JPCP 150 HMA-A	240 CRCP 150 HMA-A		270 JPCP 150 LCB	270 JPCP 150 HMA-A	255 CRCP 150 HMA-A	
13.5 to 14	255 JPCP 150 LCB	255 JPCP 150 HMA-A	240 CRCP 150 HMA-A		285 JPCP 150 LCB	285 JPCP 150 HMA-A	270 CRCP 150 HMA-A	
14.5 to 15	270 JPCP 150 LCB	270 JPCP 150 HMA-A	255 CRCP 150 HMA-A		300 JPCP 150 LCB	300 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
15.5 to 16	285 JPCP 150 LCB	270 JPCP 150 HMA-A	255 CRCP 150 HMA-A		315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
16.5 to 17	300 JPCP 150 LCB	285 JPCP 150 HMA-A	270 CRCP 150 HMA-A		330 JPCP 150 LCB	330 JPCP 150 HMA-A	300 CRCP 150 HMA-A	
> 17	315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A		345 JPCP 150 LCB	345 JPCP 150 HMA-A	300 CRCP 150 HMA-A	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

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Legend:

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TI = Traffic Index

Table 623.1E
Rigid Pavement Catalog
(South Coast/Central Coast, Type II Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	210 JPCP 300 AB	210 JPCP 105 ATPB 240 AS	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS
9.5 to 10	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS	225 JPCP 105 LCB 150 AS	225 JPCP 105 HMA-A 150 AS	240 JPCP 300 AB	240 JPCP 105 ATPB 240 AS
10.5 to 11	225 JPCP 120 LCB 180 AS	225 JPCP 120 HMA-A 180 AS	240 JPCP 390 AB		240 JPCP 120 LCB 180 AS	240 JPCP 120 HMA-A 180 AS	255 JPCP 390 AB	
11.5 to 12	240 JPCP 120 LCB 180 AS	240 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS		255 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS	
12.5 to 13	255 JPCP 150 LCB 210 AS	255 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS		270 JPCP 150 LCB 210 AS	270 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS	
13.5 to 14	255 JPCP 150 LCB 210 AS	255 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS		285 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS	
14.5 to 15	270 JPCP 150 LCB 210 AS	270 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
15.5 to 16	285 JPCP 150 LCB 210 AS	270 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
16.5 to 17	300 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS		330 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS	
> 17	315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS		345 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS	

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AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1F
Rigid Pavement Catalog (Inland Valley, Type I Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB	210 JPCP 105 HMA-A	225 JPCP 150 AB	210 JPCP 105 ATPB 105 AS	225 JPCP 105 LCB	225 JPCP 105 HMA-A	240 JPCP 150 AB	225 JPCP 105 ATPB 105 AS
9.5 to 10	210 JPCP 120 LCB	210 JPCP 120 HMA-A	240 JPCP 180 AB	225 JPCP 105 ATPB 120 AS	240 JPCP 120 LCB	255 JPCP 120 HMA-A	270 JPCP 180 AB	255 JPCP 105 ATPB 120 AS
10.5 to 11	225 JPCP 120 LCB	225 JPCP 120 HMA-A	255 JPCP 210 AB		255 JPCP 120 LCB	270 JPCP 120 HMA-A	285 JPCP 210 AB	
11.5 to 12	255 JPCP 120 LCB	255 JPCP 120 HMA-A	240 CRCP 120 HMA-A		285 JPCP 120 LCB	285 JPCP 120 HMA-A	255 CRCP 120 HMA-A	
12.5 to 13	255 JPCP 150 LCB	270 JPCP 150 HMA-A	240 CRCP 150 HMA-A		300 JPCP 150 LCB	300 JPCP 150 HMA-A	270 CRCP 150 HMA-A	
13.5 to 14	285 JPCP 150 LCB	285 JPCP 150 HMA-A	255 CRCP 150 HMA-A		315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
14.5 to 15	300 JPCP 150 LCB	300 JPCP 150 HMA-A	270 CRCP 150 HMA-A		345 JPCP 150 LCB	345 JPCP 150 HMA-A	300 CRCP 150 HMA-A	
15.5 to 16	315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A		360 JPCP 150 LCB	360 JPCP 150 HMA-A	315 CRCP 150 HMA-A	
16.5 to 17	330 JPCP 150 LCB	330 JPCP 150 HMA-A	285 CRCP 150 HMA-A		375 JPCP 150 LCB	375 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
> 17	345 JPCP 150 LCB	345 JPCP 150 HMA-A	300 CRCP 150 HMA-A		390 JPCP 150 LCB	390 JPCP 150 HMA-A	330 CRCP 150 HMA-A	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1G
Rigid Pavement Catalog (Inland Valley, Type II Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	210 JPCP 105 ATPB 240 AS	225 JPCP 105 LCB 150 AS	225 JPCP 105 HMA-A 150 AS	240 JPCP 300 AB	225 JPCP 105 ATPB 240 AS
9.5 to 10	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	240 JPCP 300 AB	225 JPCP 105 ATPB 240 AS	240 JPCP 105 LCB 150 AS	255 JPCP 105 HMA-A 150 AS	270 JPCP 300 AB	255 JPCP 105 ATPB 240 AS
10.5 to 11	225 JPCP 120 LCB 180 AS	225 JPCP 120 HMA-A 180 AS	255 JPCP 390 AB		255 JPCP 120 LCB 180 AS	270 JPCP 120 HMA-A 180 AS	285 JPCP 390 AB	
11.5 to 12	255 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS		285 JPCP 120 LCB 180 AS	285 JPCP 120 HMA-A 180 AS	255 CRCP 120 HMA-A 180 AS	
12.5 to 13	255 JPCP 150 LCB 210 AS	270 JPCP 150 HMA-A 210 AS	240 CRCP 150 HMA-A 210 AS		300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS	
13.5 to 14	285 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
14.5 to 15	300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS		345 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS	
15.5 to 16	315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS		360 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS	315 CRCP 150 HMA-A 210 AS	
16.5 to 17	330 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS		375 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
> 17	345 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS		390 JPCP 150 LCB 210 AS	390 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1H
Rigid Pavement Catalog (Desert, Type I Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB	210 JPCP 105 HMA-A	225 JPCP 150 AB	210 JPCP 105 ATPB 120 AS	225 JPCP 105 LCB	225 JPCP 105 HMA-A	240 JPCP 150 AB	225 JPCP 105 ATPB 120 AS
9.5 to 10	225 JPCP 120 LCB	225 JPCP 120 HMA-A	240 JPCP 180 AB	240 JPCP 105 ATPB 120 AS	240 JPCP 120 LCB	255 JPCP 120 HMA-A	270 JPCP 180 AB	255 JPCP 105 ATPB 120 AS
10.5 to 11	240 JPCP 120 LCB	240 JPCP 120 HMA-A	255 JPCP 210 AB		255 JPCP 120 LCB	270 JPCP 120 HMA-A	285 JPCP 210 AB	
11.5 to 12	255 JPCP 120 LCB	255 JPCP 120 HMA-A	240 CRCP 120 HMA-A		270 JPCP 120 LCB	285 JPCP 120 HMA-A	255 CRCP 120 HMA-A	
12.5 to 13	285 JPCP 150 LCB	285 JPCP 150 HMA-A	255 CRCP 150 HMA-A		315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
13.5 to 14	300 JPCP 150 LCB	300 JPCP 150 HMA-A	270 CRCP 150 HMA-A		345 JPCP 150 LCB	345 JPCP 150 HMA-A	315 CRCP 150 HMA-A	
14.5 to 15	315 JPCP 150 LCB	315 JPCP 150 HMA-A	285 CRCP 150 HMA-A		360 JPCP 150 LCB	360 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
15.5 to 16	330 JPCP 150 LCB	330 JPCP 150 HMA-A	300 CRCP 150 HMA-A		375 JPCP 150 LCB	375 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
16.5 to 17	345 JPCP 150 LCB	345 JPCP 150 HMA-A	315 CRCP 150 HMA-A		390 JPCP 150 LCB	390 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
> 17	360 JPCP 150 LCB	360 JPCP 150 HMA-A	330 CRCP 150 HMA-A		390 JPCP 150 LCB	390 JPCP 150 HMA-A	330 CRCP 150 HMA-A	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1I
Rigid Pavement Catalog (Desert, Type II Subgrade Soil) [(1), (2), (3), (4)]

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	210 JPCP 105 ATPB 240 AS	225 JPCP 105 LCB 180 AS	225 JPCP 105 HMA-A 180 AS	240 JPCP 300 AB	225 JPCP 105 ATPB 240 AS
9.5 to 10	225 JPCP 120 LCB 150 AS	225 JPCP 120 HMA-A 150 AS	240 JPCP 300 AB	240 JPCP 105 ATPB 240 AS	240 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	270 JPCP 300 AB	255 JPCP 105 ATPB 240 AS
10.5 to 11	240 JPCP 120 LCB 180 AS	240 JPCP 120 HMA-A 180 AS	255 JPCP 390 AB		255 JPCP 120 LCB 180 AS	270 JPCP 120 HMA-A 180 AS	285 JPCP 390 AB	
11.5 to 12	255 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS		270 JPCP 120 LCB 180 AS	285 JPCP 120 HMA-A 180 AS	255 CRCP 120 HMA-A 180 AS	
12.5 to 13	285 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
13.5 to 14	300 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS		345 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	315 CRCP 150 HMA-A 210 AS	
14.5 to 15	315 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS		360 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
15.5 to 16	330 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS		375 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
16.5 to 17	345 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	315 CRCP 150 HMA-A 210 AS		390 JPCP 150 LCB 210 AS	390 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
> 17	360 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS		390 JPCP 150 LCB 210 AS	390 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	

Notes:

(1) Thicknesses shown are for doweled JPCP only. Not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1J
Rigid Pavement Catalog
(Low Mountain/South Mountain, Type I Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB	210 JPCP 105 HMA-A	225 JPCP 150 AB	210 JPCP 105 ATPB 120 AS	225 JPCP 105 LCB	225 JPCP 105 HMA-A	225 JPCP 150 AB	225 JPCP 105 ATPB 120 AS
9.5 to 10	210 JPCP 120 LCB	210 JPCP 120 HMA-A	225 JPCP 180 AB	225 JPCP 105 ATPB 120 AS	240 JPCP 120 LCB	240 JPCP 120 HMA-A	255 JPCP 180 AB	240 JPCP 105 ATPB 120 AS
10.5 to 11	225 JPCP 120 LCB	225 JPCP 120 HMA-A	240 JPCP 210 AB		255 JPCP 120 LCB	255 JPCP 120 HMA-A	270 JPCP 210 AB	
11.5 to 12	240 JPCP 120 LCB	255 JPCP 120 HMA-A	240 CRCP 120 HMA-A		270 JPCP 120 LCB	285 JPCP 120 HMA-A	255 CRCP 120 HMA-A	
12.5 to 13	270 JPCP 150 LCB	285 JPCP 150 HMA-A	255 CRCP 150 HMA-A		300 JPCP 150 LCB	315 JPCP 150 HMA-A	270 CRCP 150 HMA-A	
13.5 to 14	285 JPCP 150 LCB	300 JPCP 150 HMA-A	255 CRCP 150 HMA-A		315 JPCP 150 LCB	330 JPCP 150 HMA-A	285 CRCP 150 HMA-A	
14.5 to 15	300 JPCP 150 LCB	315 JPCP 150 HMA-A	270 CRCP 150 HMA-A		345 JPCP 150 LCB	360 JPCP 150 HMA-A	315 CRCP 150 HMA-A	
15.5 to 16	315 JPCP 150 LCB	330 JPCP 150 HMA-A	285 CRCP 150 HMA-A		360 JPCP 150 LCB	375 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
16.5 to 17	330 JPCP 150 LCB	345 JPCP 150 HMA-A	300 CRCP 150 HMA-A		375 JPCP 150 LCB	390 JPCP 150 HMA-A	330 CRCP 150 HMA-A	
> 17	345 JPCP 150 LCB	360 JPCP 150 HMA-A	300 CRCP 150 HMA-A		390 JPCP 150 LCB	405 JPCP 150 HMA-A	330 CRCP 150 HMA-A	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

Table 623.1K
Rigid Pavement Catalog
(Low Mountain/South Mountain, Type II Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	210 JPCP 105 LCB 150 AS	210 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	210 JPCP 105 ATPB 240 AS	225 JPCP 105 LCB 150 AS	225 JPCP 105 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS
9.5 to 10	210 JPCP 120 LCB 150 AS	210 JPCP 120 HMA-A 150 AS	225 JPCP 300 AB	225 JPCP 105 ATPB 240 AS	240 JPCP 120 LCB 150 AS	240 JPCP 120 HMA-A 150 AS	255 JPCP 300 AB	240 JPCP 105 ATPB 240 AS
10.5 to 11	225 JPCP 120 LCB 180 AS	225 JPCP 120 HMA-A 180 AS	240 JPCP 390 AB		255 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	270 JPCP 390 AB	
11.5 to 12	240 JPCP 120 LCB 180 AS	255 JPCP 120 HMA-A 180 AS	240 CRCP 120 HMA-A 180 AS		270 JPCP 120 LCB 180 AS	285 JPCP 120 HMA-A 180 AS	255 CRCP 120 HMA-A 180 AS	
12.5 to 13	270 JPCP 150 LCB 210 AS	285 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		300 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS	
13.5 to 14	285 JPCP 150 LCB 210 AS	300 JPCP 150 HMA-A 210 AS	255 CRCP 150 HMA-A 210 AS		315 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS	
14.5 to 15	300 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS	270 CRCP 150 HMA-A 210 AS		345 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS	315 CRCP 150 HMA-A 210 AS	
15.5 to 16	315 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS	285 CRCP 150 HMA-A 210 AS		360 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
16.5 to 17	330 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS		375 JPCP 150 LCB 210 AS	390 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	
> 17	345 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS	300 CRCP 150 HMA-A 210 AS		390 JPCP 150 LCB 210 AS	1.35 JPCP 150 HMA-A 210 AS	330 CRCP 150 HMA-A 210 AS	

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 10 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement

CRCP = Continuously Reinforced Concrete Pavement

LCB = Lean Concrete Base

HMA-A = Hot Mix Asphalt (Type A)

ATPB = Asphalt Treated Permeable Base

AB = Class 2 Aggregate Base

AS = Class 4 Aggregate Subbase

TI = Traffic Index

Table 623.1L
Rigid Pavement Catalog
(High Mountain/High Desert, Type I Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	240 JPCP 105 LCB	255 JPCP 105 HMA-A	255 JPCP 150 AB	240 JPCP 105 ATPB 120 AS	255 JPCP 105 LCB	270 JPCP 105 HMA-A	270 JPCP 150 AB	270 JPCP 105 ATPB 120 AS
9.5 to 10	255 JPCP 120 LCB	255 JPCP 120 HMA-A	270 JPCP 180 AB	270 JPCP 105 ATPB 120 AS	270 JPCP 120 LCB	270 JPCP 120 HMA-A	285 JPCP 180 AB	270 JPCP 105 ATPB 120 AS
10.5 to 11	270 JPCP 120 LCB	270 JPCP 120 HMA-A	285 JPCP 210 AB		285 JPCP 120 LCB	285 JPCP 120 HMA-A	300 JPCP 210 AB	
11.5 to 12	285 JPCP 120 LCB	285 JPCP 120 HMA-A			315 JPCP 120 LCB	315 JPCP 120 HMA-A		
12.5 to 13	300 JPCP 150 LCB	315 JPCP 150 HMA-A			330 JPCP 150 LCB	345 JPCP 150 HMA-A		
13.5 to 14	315 JPCP 150 LCB	330 JPCP 150 HMA-A			345 JPCP 150 LCB	360 JPCP 150 HMA-A		
14.5 to 15	330 JPCP 150 LCB	345 JPCP 150 HMA-A			360 JPCP 150 LCB	375 JPCP 150 HMA-A		
15.5 to 16	345 JPCP 150 LCB	360 JPCP 150 HMA-A			375 JPCP 150 LCB	390 JPCP 150 HMA-A		
16.5 to 17	360 JPCP 150 LCB	375 JPCP 150 HMA-A			390 JPCP 150 LCB	405 JPCP 150 HMA-A		
> 17	375 JPCP 150 LCB	375 JPCP 150 HMA-A			405 JPCP 150 LCB	405 JPCP 150 HMA-A		

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 45 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP =	Jointed Plain Concrete Pavement	ATPB =	Asphalt Treated Permeable Base
CRCP =	Continuously Reinforced Concrete Pavement	AB =	Class 2 Aggregate Base
LCB =	Lean Concrete Base	AS =	Class 4 Aggregate Subbase
HMA-A =	Hot Mix Asphalt (Type A)	TI =	Traffic Index

Table 623.1M
Rigid Pavement Catalog
(High Mountain/Low Mountain, Type II Subgrade Soil) (1), (2), (3), (4)

TI	Lateral Support (mm)				No Lateral Support (mm)			
< 9	240 JPCP 105 LCB 150 AS	255 JPCP 105 HMA-A 150 AS	255 JPCP 300 AB	240 JPCP 105 ATPB 240 AS	255 JPCP 105 LCB 150 AS	270 JPCP 105 HMA-A 150 AS	270 JPCP 300 AB	270 JPCP 105 ATPB 240 AS
9.5 to 10	255 JPCP 120 LCB 150 AS	255 JPCP 120 HMA-A 150 AS	270 JPCP 300 AB	270 JPCP 105 ATPB 240 AS	270 JPCP 120 LCB 150 AS	270 JPCP 120 HMA-A 150 AS	285 JPCP 300 AB	270 JPCP 105 ATPB 240 AS
10.5 to 11	270 JPCP 120 LCB 180 AS	270 JPCP 120 HMA-A 180 AS	285 JPCP 390 AB		285 JPCP 120 LCB 180 AS	285 JPCP 120 HMA-A 180 AS	300 JPCP 390 AB	
11.5 to 12	285 JPCP 120 LCB 180 AS	285 JPCP 120 HMA-A 180 AS			315 JPCP 120 LCB 180 AS	315 JPCP 120 HMA-A 180 AS		
12.5 to 13	300 JPCP 150 LCB 210 AS	315 JPCP 150 HMA-A 210 AS			330 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS		
13.5 to 14	315 JPCP 150 LCB 210 AS	330 JPCP 150 HMA-A 210 AS			345 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS		
14.5 to 15	330 JPCP 150 LCB 210 AS	345 JPCP 150 HMA-A 210 AS			360 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS		
15.5 to 16	345 JPCP 150 LCB 210 AS	360 JPCP 150 HMA-A 210 AS			375 JPCP 150 LCB 210 AS	390 JPCP 150 HMA-A 210 AS		
16.5 to 17	360 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS			390 JPCP 150 LCB 210 AS	405 JPCP 150 HMA-A 210 AS		
> 17	375 JPCP 150 LCB 210 AS	375 JPCP 150 HMA-A 210 AS			405 JPCP 150 LCB 210 AS	405 JPCP 150 HMA-A 210 AS		

Notes:

(1) Thicknesses shown for JPCP are for doweled pavement only. The thickness shown in these tables are not valid for nondoweled JPCP.

(2) Includes 45 mm sacrificial wearing course for future grinding of JPCP/CRCP.

(3) Portland cement concrete may be substituted for LCB when justified for constructibility or traffic handling. If Portland cement concrete is used in lieu of LCP, it must be placed in a separate lift than JPCP and must not be bonded to the JPCP.

(4) If ATPB is needed for TIs > 10.0 to perpetuate an existing treated permeable layer, place the ATPB between the surface layer (JPCP or CRCP) and the base layer. No deduction is made to the thickness of the base and subbase layers on account of the ATPB.

Legend:

JPCP = Jointed Plain Concrete Pavement
CRCP = Continuously Reinforced Concrete Pavement
LCB = Lean Concrete Base
HMA-A = Hot Mix Asphalt (Type A)
ATPB = Asphalt Treated Permeable Base
AB = Class 2 Aggregate Base
AS = Class 4 Aggregate Subbase
TI = Traffic Index

623.2 Mechanistic-Empirical Method

For information on Mechanistic-Empirical Design application and requirements, see Index 606.3.

Topic 624 – Engineering Procedures for Pavement Preservation

An overview of rigid pavement preservation strategies is discussed in the "Rigid Pavement Preservation and Rehabilitation Guidelines," which can be found on the Department pavement website under Technical Guidance. Some of the preservation strategies discussed in the guide include the following or combinations of the following:

- Seal random cracks
- Joint seal, repair/replace existing joint seals
- Spall repair
- Grooving
- Grinding to restore surface texture
- Special surface treatments (such as methacrylate, polyester concrete, and others). These strategies are normally used on bridge decks but can be applied, in limited situations, to rigid pavements for repair of problem areas.

Topic 625 - Engineering Procedures for Pavement and Roadway Rehabilitation

625.1 Rigid Pavement Rehabilitation Strategies

(1) *Strategies.* An overview of rigid pavement strategies for pavement rehabilitation and roadway rehabilitation is discussed in the "Rigid Pavement Preservation and Rehabilitation Guidelines," which can be found on the Department Pavement website under Technical Guidance. Some rehabilitation strategies discussed in the guide include the following or combinations of the following:

(a) Grinding to correct faulting.

(b) Edge drain retrofit.

(c) Dowel bar retrofit. Guidelines for selecting and engineering dowel bar retrofit projects can be found on the Department pavement website.

(d) Slab replacement. The use of rapid strength concrete in the replacement of concrete slabs should be given consideration to minimize traffic impacts and open the facility to traffic in a minimal amount of time. Slab replacements may include replacing existing cement treated base or lean concrete base with rapid strength concrete. For further information (including information on rapid strength concrete) see the "Slab Replacement Guidelines" on the Department Pavement website.

(e) Unbonded rigid overlay with flexible interlayer.

(f) Crack, seat, and flexible pavement overlay with pavement reinforcing fabric.

(g) Lane replacement. Lane replacements are engineered using the catalogs found in Index 623.1. Attention should be given to maintaining existing drainage patterns underneath the surface layer, (see Chapter 650 for further guidance). For further information see "Design Tools for Slab and Lane Replacements", on the Department Pavement website.

On resurfacing projects, the entire paved shoulder and traveled way shall be resurfaced. Not only does this help provide a smoother finished surface, it also benefits bicyclists and pedestrians when they are allowed to use the shoulder.

(2) *Preparation of Existing Pavement.* <u>Existing pavement distresses should be repaired before overlaying the pavement.</u> Cracks wider than 5 mm should be sealed; loose pavement

removed and patched; spalls repaired; and broken slabs or punchouts replaced. This applies to both lanes and adjacent shoulders (flexible and rigid). The Materials Report should include a reminder of these preparations. Crack sealants should be placed 5 mm below grade to allow for expansion (i.e. recess fill) and to alleviate a potential bump if the overlay is placed. For information and criteria for slab replacements, see Chapter 2 of the Slab Replacement Guidelines on the Department pavement web site.

(3) *Selection.* The selection of the appropriate strategy should be based upon life-cycle cost, load transfer efficiency of the joints, materials testing, ride quality, safety, maintainability, constructibility, visual inspection of pavement distress, and other factors listed in Chapter 610. The Materials Report should discuss any historical problems observed in the performance of rigid pavement constructed with aggregates found near the proposed project and subjected to similar physical and environmental conditions.

625.2 Mechanistic-Empirical Method

For information on Mechanistic-Empirical Design application and requirements, see Index 606.3.

Topic 626 - Other Considerations

626.1 Traveled Way

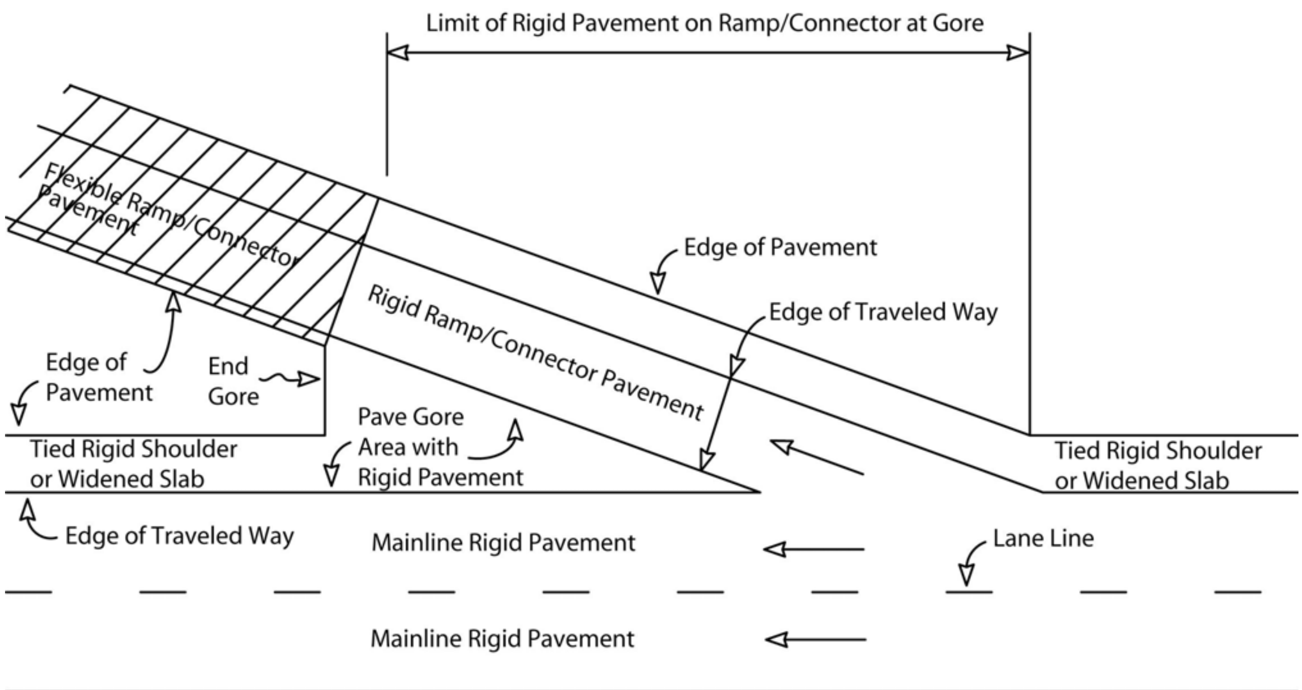
(1) *Mainline.* No additional considerations.

(2) *Ramps and Connectors.* If tied rigid shoulders or widened slabs are used on the mainline, then the ramp or connector gore area (including ramp traveled way adjacent to the gore area) should also be constructed with rigid pavement (see Figure 626.1). This will minimize deterioration of the joint between flexible and rigid pavement. When the ramp or connector traveled way is rigid pavement, utilize the same base and thickness for the gore area as that to be used under the ramp traveled way, especially when concrete shoulders are utilized on the mainline. Note that in order to optimize constructability, any concrete pavement structure used for mainline concrete shoulders should still be perpetuated through the gore area. If the base is Treated Permeable Base (TPB) under the ramp's traveled way and shoulder, TPB should still be utilized in the ramp gore areas as well.

(3) *Ramp Termini.* Rigid pavement is sometimes placed at ramp termini instead of flexible pavement where there is projected heavy truck traffic (TIs greater than 12) to preclude pavement failure such as rutting or shoving from vehicular braking, turning movements, and oil dripping from vehicles. Once a design TI is selected for the ramp in accordance with Index 613.5, follow the requirements in Index 623.1 to engineer the rigid pavement structure for the ramp termini. The length of rigid pavement to be placed at the termini will depend on the geometric alignment of the ramp, ramp grades, and the length of queues of stopped traffic. The rigid pavement should extend to the first set of signal loops on signalized intersections. A length of 45 m should be considered the minimum on unsignalized intersections. Special care should be taken to assure skid resistance in conformance with current standard specifications in the braking area, especially where oil drippage is concentrated. End anchors or transitions should be used at flexible/rigid pavement joints. The Department pavement website has additional information and training for engineering pavement for intersections and rigid ramp termini.

Figure 626.1

Rigid Pavement at Ramp or Connector Gore Area



Notes: 1) Not all details shown
2) Off ramp shown. Same conditons apply for on ramps.

626.2 Shoulder

The types of shoulders that are used for rigid pavements are shown in Figure 626.2A and can be categorized into the following three types:

(1) *Tied Rigid Shoulders.* These are shoulders that are built with rigid pavement that are tied to the adjacent lane with tie bars. These shoulders provide lateral support to the adjacent lane, which improves the long-term performance of the adjacent lane, reducing the need for maintenance or repair of the lane. To obtain the maximum benefit, these shoulders should be built monolithically with the adjacent lane (i.e., no contact joints). This will create aggregate interlock between the lane and shoulder, which provides increased lateral support. In order to build the lane and shoulder integrally, the shoulder cross slope needs to match the lane cross slope which may require a design exception (see Index 302.2 for further discussion).

The pavement structure for the tied rigid shoulder should match the pavement structure of the adjacent traffic lane. Special delineation of concrete shoulders may be required to deter the use of the shoulder as a traveled lane. District Traffic Operations should be consulted to determine the potential need for anything more than the standard edge stripe.

Tied rigid shoulders are the most adaptable to future widening and conversion to a lane. They should be the preferred shoulder type when future widening is planned within the design life of the pavement or where the shoulder will be used temporarily as a truck or bus lane. Where the shoulder is expected to be converted into a traffic lane in the future, the shoulder should be built to the same geometric and pavement standards as the lane. Additionally, the shoulder width should match the width of the future lane.

(2) *Widened slab.* Widened slabs involve constructing the concrete panel for the lane adjacent to the shoulder 4.27 m wide in lieu of the prescribed lane width. The additional width becomes part of the shoulder width and provides lateral support to the adjacent lane. Widened slabs provide as good or better lateral support than tied rigid shoulders at a lower initial cost provided that trucks and buses are kept at least 0.6 m from the edge of the slab. A rumble strip or a raised pavement marking next to the pavement edge line of widened concrete slabs helps discourage trucks and buses from driving on the outside 0.6 meters of the slab. The use of rumble strips or raised markings requires approval from District Traffic Operations.

Widened slabs are most useful in areas where lateral support is desired but future widening is not anticipated or where there is a need to have a different cross slope on the shoulder than that of the adjacent lane.

(3) *Unsupported Shoulders.* Unsupported shoulders are flexible shoulders that are not built with a widened slab or rigid shoulders that are not tied to the adjacent lane and not built adjacent to a widened slab. These shoulders do not provide lateral support to the adjacent lane. Although unsupported shoulders may have lower initial costs, they do not perform as well as tied rigid shoulders or widened slabs, which can lead to higher maintenance costs, user delays, and life cycle costs.

(4) *Selection Criteria.* It is preferred that shoulders be constructed of the same material as the traveled way pavement (in order to facilitate construction, improve pavement performance, and reduce maintenance cost). However, shoulders adjacent to rigid pavement traffic lanes can be either rigid or flexible with the following conditions:

(a) Tied rigid shoulders shall be used for:

- **Rigid pavements constructed in the high mountain and high desert climate regions (see climate map in Topic 615)**
- **Paved buffers between rigid High-Occupancy Vehicle (HOV) lanes and rigid mixed flow lanes. Same for High-Occupancy Toll (HOT) lanes**

- **Rigid ramps to and from truck inspection stations**

(b) Either tied rigid shoulders or widened slabs shall be used for:

- **continuously reinforced concrete pavement**
- **horizontal radii 90 m or less**
- **Truck and bus only lanes**

Where tied rigid shoulders or widened slabs are used, they shall continue through ramp and gore areas (see Figure 626.2B).

Because heavy trucks cause deterioration by repeated heavy loading on the outside edge of pavement, at the corners, and the midpoint of the slab, widened slabs or tied rigid shoulders should be used for heavy truck routes with a TI greater than or equal to 14.0.

In those instances where flexible shoulders are used with rigid pavement, the minimum flexible shoulder thickness should be determined in accordance with Topic 633.

These conditions apply to all rigid pavement projects including new construction, reconstruction, widening, adjacent lane replacements, and shoulder replacements. Typically existing flexible shoulders next to rigid pavement are not replaced for rehabilitation projects that involve only grinding, dowel bar retrofits, and individual slab replacements. Consideration should be given to replacing flexible shoulders with tied rigid shoulders or widened slabs when the adjacent lane is being replaced or overlaid with a rigid pavement. The District determines when an existing flexible shoulder is replaced with a rigid shoulder or widened slab.

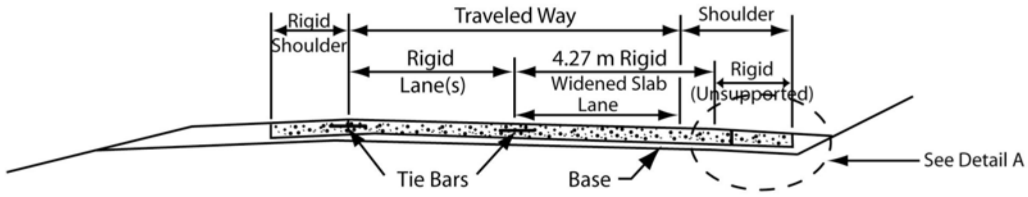
The shoulder pavement structure selected must meet or exceed the pavement design life standards in Topic 612. In selecting whether to construct rigid or flexible shoulders the following factors should be considered:

- Life-cycle cost of the shoulder.
- Ability and safety of maintenance crews to maintain the shoulder. In confined areas, such as in front of retaining walls or narrow shoulders, and on high volume roadways (AADT > 150,000) consideration should be given to engineering a shoulder that requires the least amount of maintenance, even if it is more expensive to construct.
- Future plans to widen the facility or convert the shoulder to a traffic lane.
- Width of shoulder. When shoulder widths are less than 1.5 meters, tied rigid shoulders are preferable to a widened rigid slab and narrow flexible shoulder, less than 0.9 m, for both constructibility and maintainability.

See Index 1003.6(2) for surface quality guidance for highways open to bicyclists.

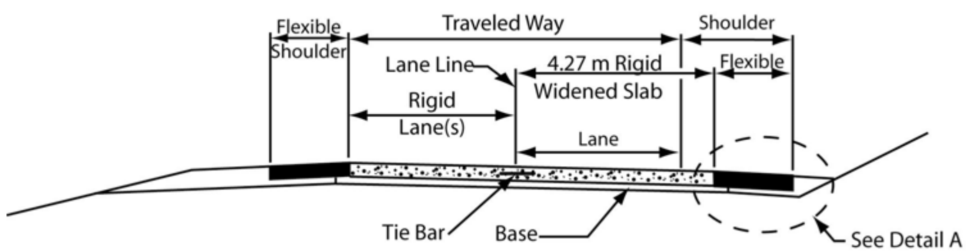
Figure 626.2A

Rigid Pavement and Shoulder Details



RIGID SHOULDERS

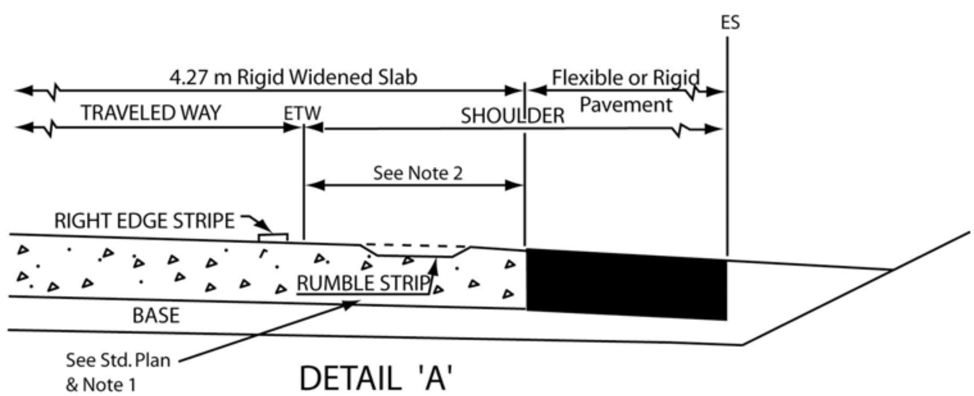
No Scale



FLEXIBLE SHOULDERS

No Scale

NOTE: These illustrations are only to show nomenclature and are not to be used for geometric cross section details.

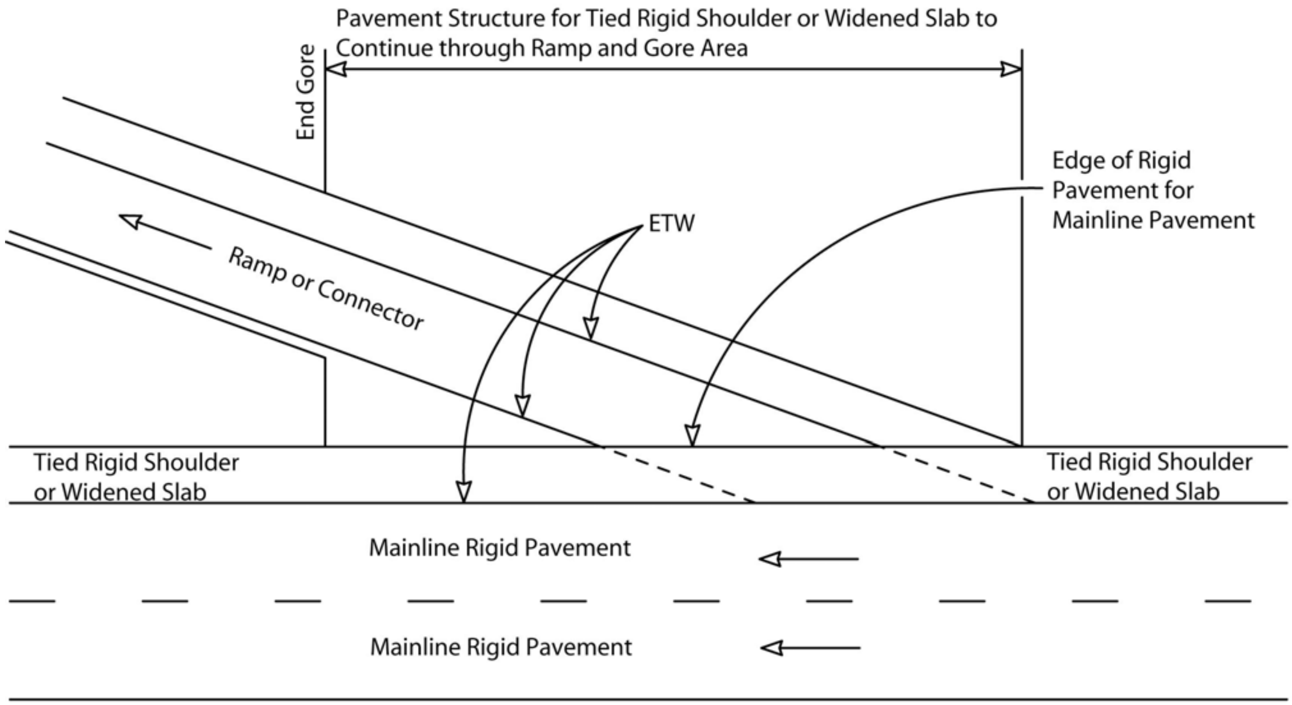


DETAIL 'A'

NOTES:
1. Use of Rumble Strips is determined in consultation with District Traffic Operations.
2. 670 mm for 3.6 meter lane.
   610 mm for 3.66 meter lane.
3. Right side widened slab is shown. Left side widened slab is similar.

Figure 626.2B

Rigid Shoulders Through Ramp and Gore Areas



Notes: 1) Not all details shown
2) Off ramp shown. Same conditions apply for on ramps.

626.3 Intersections

Standard joint spacing patterns found in the Standard Plans do not apply to intersections. Special paving details for intersections need to be included in the project plans. Special consideration needs to be given to the following features when engineering a rigid pavement intersection:

- Intersection limits
- Joint types and joint spacing
- Joint patterns
- Slab dimensions
- Pavement joints at utilities
- Dowel bar and tie bar placement

Additional information and training is available on the Department Pavement website.

626.4 Roadside Facilities

(1) *Safety Roadside Rest Areas and Vista Points.* If rigid pavement is selected for some site-specific reason(s), the pavement structures used should be sufficient to handle projected loads at most roadside facilities. To select the pavement structure, determine the Traffic Index either from traffic studies and projections developed for the project or the values found in Table 613.5B, whichever is greater. Then select the appropriate pavement structure from the catalog in Index 623.1.

Joint spacing patterns found in the Standard Plans do not apply to parking areas. Joint patterns should be engineered as square as possible. Relative slab dimensions should be approximately 1:1 to 1:1.25, transverse-to-longitudinal. Transverse and longitudinal joints should be perpendicular to each other. Joints are doweled in one direction and tied in the other in accordance with Index 622.4. Special attention should be given to joint patterns around utility covers and manholes.

Use guidelines for intersections in Index 626.3 for further information.

(2) *Park and Ride Facilities.* Flexible pavement should be used for park and ride facilities. If transit buses access the park and ride facility, use the procedures for bus pads in this Index for engineering bus access.

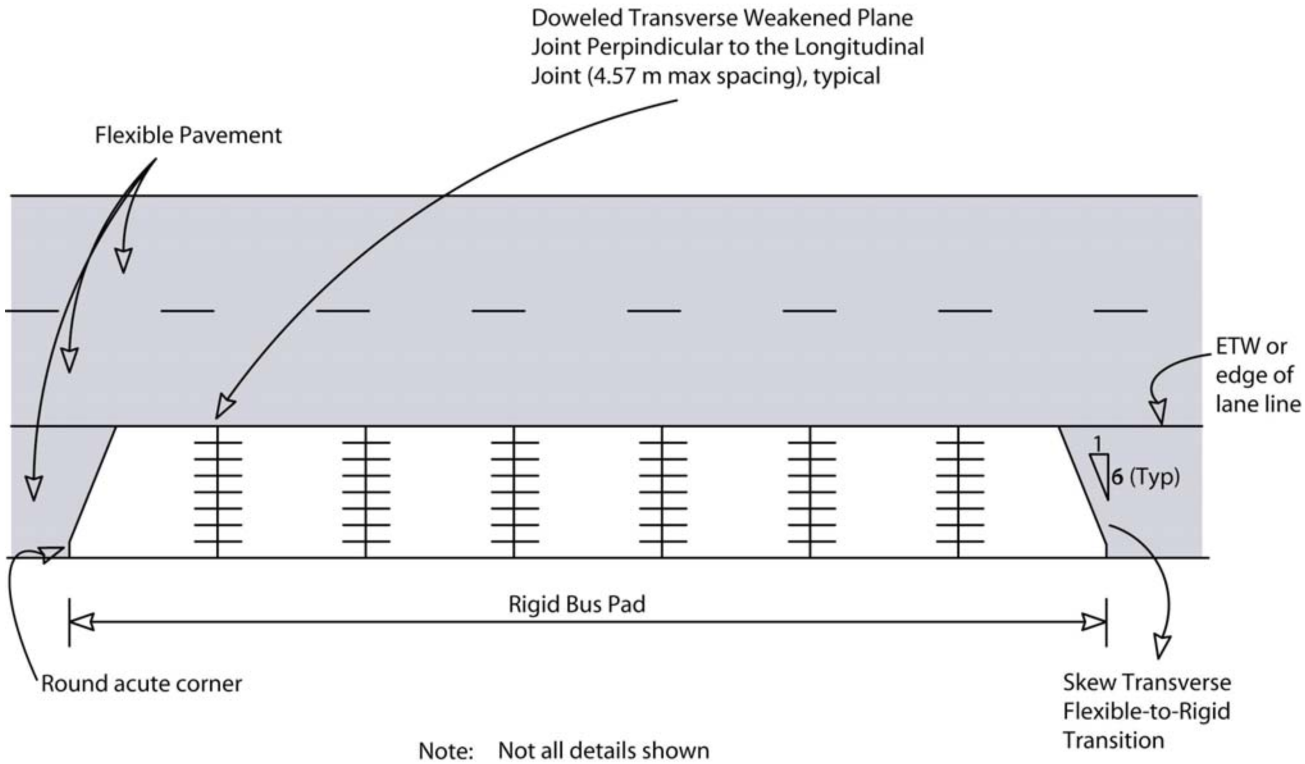
(3) *Bus Pads.* Bus pads are subjected to similar stresses as intersections; however, it is not practical to engineer rigid bus pads according to the Traffic Index, or according to bus counts. The minimum pavement structure for bus pads should be 255 mm JPCP with dowel bars at transverse joints on top of 150 mm lean concrete base or Type A hot mixed asphalt (230 mm CRCP may be substituted for 255 mm JPCP). For Type II soil as described in Table 623.1A, include 150 mm of aggregate subbase. Type III soil should be treated in accordance with Index 614.4. Where local standards are more conservative than the pavement structures mentioned above, local standards should govern.

Relative slab dimensions for bus pads should be approximately 1:1 to 1:1.25, transverse-to-longitudinal. The width of the bus pad should be no less than the width of the bus plus 1.2 m. If the bus pad extends into the traveled way, the rigid bus pad should extend for the full width of the lane occupied by buses. The minimum length of the bus pad should be 1.5 times the length of the bus(es) that will use the pad at any given time. This will provide some leeway for variations in where the bus stops. Additional length of rigid pavement should be considered for approaches and departures from the bus pad since these locations may be subjected to the same stresses from buses as the bus pad. A 35 m length of bus pad (which is approximately 250% to 300% times the length of typical 12.2 m buses) should provide sufficient length for bus approach and departure. The decision whether to use rigid pavement for bus approach and departure to/from bus pads is the responsibility of the District.

An end anchor may improve long-term performance at the flexible-to-rigid pavement transition. Doweled transverse joints should be perpendicular to the longitudinal joint at maximum 4.57 m spacing, but consider skewing (at 6:1 typical) entrance/exit transverse flexible-to-rigid transitions, note that since acute corners can fail prematurely, acute corners should be rounded (see Figure 626.4). Special care should be taken to assure skid resistance in conformance with current Standard Specifications in the braking area, especially where oil drippage is concentrated.

Figure 626.4

Rigid Bus Pad



Note: Not all details shown